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GB 2218554 A GB 2209604 A

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(54) Sensor cable

(57) A sensor cable 21, 22 for detecting the presence of water has electrical conductors 23, 24 embedded in open channels in a sheath 22 of plastics material which is impermeable to water. This provides an improved performance over prior art cables because it prevents "wicking" between component parts of the cable.

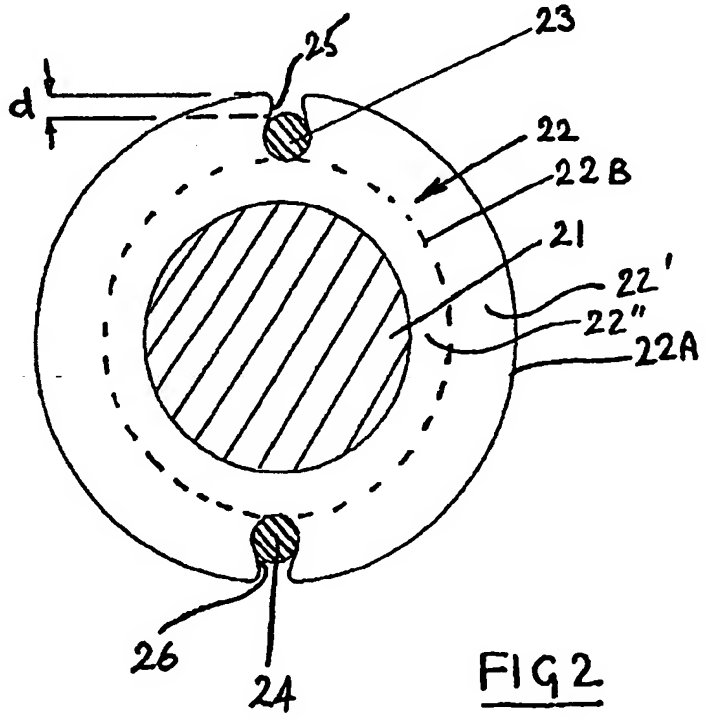


FIG 2

GB 2 275 555 A

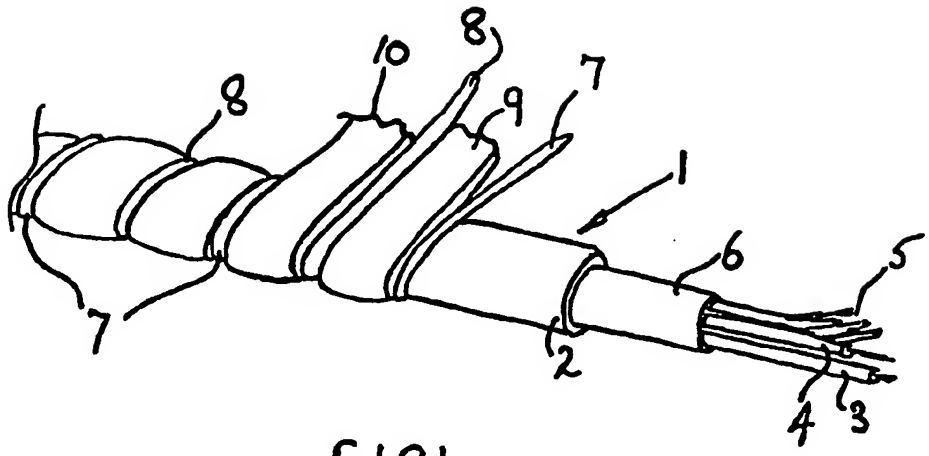
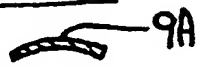


FIG 1

FIG 1A



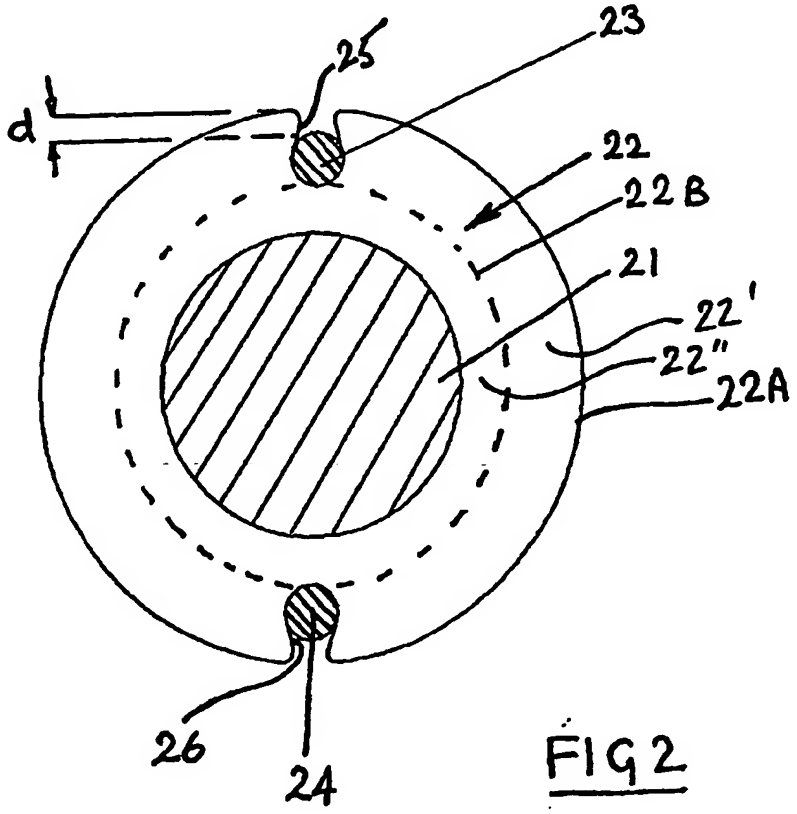


FIG 2

SENSOR CABLE

This invention relates to sensor cables, particularly but not exclusively cables for sensing the presence of water.

A known water sensing cable is shown in Figure 1 of the drawings and comprises a cable core 1 including an extruded plastics sheath 2 housing a pair of insulated electrical conductors 3 and 4 and earth wires 5 surrounded by a plastic/aluminium laminate screening layer 6.

Surrounding the core 1 is a wrapping of bare electrically conductive sensor wires 7 and 8 held in helical mutually-spaced-apart relationship on the surface of the core 1 by helically-wrapped plastics tapes 9 and 10. These tapes 9 and 10 have a curved cross section 9A and a cross section of tape 9 is shown in Figure 1A to illustrate this.

In the cable of Figure 1 the bare wires 7 and 8 are protected against contacting the side of a duct or the like where the cable is laid by means of the tapes 9 and 10 which, by virtue of their convex transverse cross section, project radially further outwardly than the wires giving the physical protection referred to.

In the use of the cable any liquid e.g. water which comes into contact with the cable causes a change in resistance between the wires 7 and 8 which can be measured to thereby detect the presence of the liquid.

We have discovered that the cable described in Figures 1 and 1A can provide an erroneous reading and we believe this may be due to capilliary action between the sensor wires 7 and 8 through the interfaces between the spacer tapes 9 and 10 and the surface of the sheath 2 of the cable core 1.

According to the present invention a sensor cable comprises a unitary outer sheath having at least two conductors held in respective open channels in the sheath and below the surface of the sheath, the sheath being impermeable to liquids such as water.

Preferably the unitary sheath is an extruded dielectric sheath enclosing a cable core incorporating further conductors.

In order that the invention can be more clearly understood reference will now be made to the drawing in which Figure 1 shows a perspective view of an end of a sensor cable according to the prior art and already referred to in the preamble,
Figure 1A shows a cross section of a part of Figure 1 and
Figure 2 is a cross section of a sensor cable according to an embodiment of the present invention.

Referring now to Figure 2 the sensor cable comprises a cable core 21 which can be the same as the core 1 shown in Figure 1 but may be different. The cable of Figure 2 can utilise any type of core for its construction for example a simple filler, electrical, optical or mechanical elements. Cable core 21 is encapsulated within a sheath 22 which has been extruded directly over the core 21.

This sheath has two electrodes 23 and 24 held in respective helically arranged open channels 25 and 26 formed in the surface of the sheath.

This design has the benefit that because the sheath 22 is impermeable to water there can be no water path between the two sensor electrodes 23 and 24 other than a path circumferentially around the surface 22A of the sheath 22. Capilliary action (also known as "wicking") cannot take place between the two electrodes through the sheath.

The sensor electrodes can be of any conductive material and are for example stainless steel or tinned annealed copper wire, and the channels which locate the electrodes are helical. The depth d to which the electrodes are embedded is approximately 1mm but may vary. This can be achieved in several ways and two methods will now be described, the first method being preferred.

The sheath 22, which is of a deformable dielectric material, for example polyethylene, is heated until it softens sufficiently for the sensor electrodes to be helically laid in and therefore embedded into, its surface. The depth to which the electrodes are embedded is controlled by the heating regime used to soften the surface. The electrode may be preheated to aid this process if required.

In an alternative technique, the electrodes are embedded during the extrusion process of the outer sheath 22. This is achieved by running the wires directly into the back of an extruder head and tight against the outer wall of the core tube of the extruder. The depth d to which the electrodes are embedded is controlled by the "pushing up" of the sheath material as it leaves the die of the extruder head. A technique similar to this is described in our earlier UK Patent 2113903B and a man skilled in the art would be able to adapt that technique to achieve the desired depth of conductor and open channel configuration.

In both techniques, as the electrodes are embedded into the outer sheath whilst the material is hot, there will be limited adhesion between the electrodes and the sheath. This, coupled with the helix and the nature of the channel, will prevent the electrode from protruding above the level of the outer sheath surface 22A.

The cable and its method of manufacture could be modified as indicated in Fig 2 by the broken line 22B. This represents the interface between inner and outer concentric portions of 22' and 22" which go to make up the integral sheath 22.

In manufacturing this modified embodiment of the invention, firstly the inner portion 22" of the sheath is extruded over the core 21 and the product is then passed through a second extruder together with the wires 23 and 24 to form the second outer portion 22' as previously described. Here though the two portions of the sheath would be of for example respective different grades of polyethylene so that the inner portion 22" prevents the wires 23 and 24 sinking too close to the core 21 and in fact could very accurately determine the radial separation of the two wires. Thus 22" could have a slightly higher melting point so that during the second pass to extrude 22', 22" does not deform to any great extent and is in contact with the wires 23 and 24, yet nevertheless bonds intimately with portion 22' so that sheath 22 is of unitary construction in the finished cable.

The nominal diametric spacing between the electrodes in this embodiment of the invention is approximately 6mm but may be varied.

CLAIMS:-

1. A sensor cable comprising a unitary outer sheath having at least two conductors held in respective open channels in the sheath and below the surface of the sheath, the sheath being impermeable to liquids such as water.

2. A cable as claimed in claim 1, wherein the sheath is made of extruded plastics material.

3. A method of making a sensor cable comprising embedding at least two conductors in an outer sheath of the cable while the sheath is in a plasticly deformable condition, whereby to produce the cable in which the two conductors are held in respective open channels in the sheath and below the surface of the sheath, the sheath being impermeable to liquids such as water.

4. A method is claimed in claim 3, wherein the sheath comprises an inner portion and an outer portion intimately bonded together.

5. A sensor cable and a method of making the cable, substantially as hereinfor described with reference to and as illustrated in Figure 2 of the accompanying drawing.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report) -6-

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Relevant Technical fields

(i) UK Cl (Edition L) G4N (NCLC,NCSE)

(ii) Int Cl (Edition 5) G01M 3/16; G08B 21/00

Search Examiner
D L SUMMERHAYES

Databases (see over)
(i) UK Patent Office

(ii)

Date of Search
26 APRIL 1993

Documents considered relevant following a search in respect of claims 1-5

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2218554 A (JUNKOSHA) see whole document	1 at least
X	GB 2209604 A (JUNKOSHA) see whole document	1 at least

Category	Identity of document and relevant passages	Relevant to claim(s)

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